FOREST PEST CONDITIONS IN CALIFORNIA 1962

Official Report of the

CALIFORNIA FOREST PEST CONTROL ACTION COUNCIL

The California Forest Pest Control Action Council was formed in 1951 in recognition of the need for close cooperation among land managers concerned with forest pest problems. Primarily an advisory and coordinating group, the Council sponsors a Statewide cooperative forest pest detection survey; publishes an annual report of forest pest conditions; studies, endorses, and supports desirable pest control actions; reviews control needs and programs, and stimulates action where needed; and provides a forum for the exchange of pest control information. The California State Board of Forestry has designated the Council as its official advisory group for forest insect, disease and animal problems.

The Council comprises the following organizations:

California Forest Protective Association
California Redwood Association
State of California
- Department of Agriculture
- Department of Conservation
- Department of Fish and Game
- Department of Parks and Recreation
- University of California

U. S. Department of Agriculture
- Forest Service

U. S. Department of the Interior
- Bureau of Indian Affairs
- Bureau of Land Management
- Fish and Wildlife Service
- National Park Service

Western Pine Association

FOREST PEST CONDITIONS IN CALIFORNIA - 1962 was prepared by the Forest Service and the Fish and Wildlife Service in cooperation with other member organizations of the Council. It was duplicated and distributed by the California Division of Forestry.

Cover: Thrifty young-mature ponderosa pines killed by bark beetles in the Mother Lode Infestation.

Sacramento February 1963

FOREST PEST DETECTION IN CALIFORNIA - 1962

The information on which this report is based comes from several sources, the most important of which is the California Cooperative Forest Pest Detection Survey. This survey was initiated by the Council in 1951 to provide the broadest possible base for pest-condition appraisals, and to enlist the services of as many field observers as possible. It operates in the following way: pest conditions, ranging in size from single damaged trees to major outbreaks involving hundreds of acres, are detected by individual cooperators in the course of their usual field duties. In many cases the cause of damage is unknown and the cooperator is interested primarily in having the pest identified. A standard report form is used to facilitate processing.

The Forest Service Regional Office in San Francisco acts as a clearing house for the survey information, identifying unknown insect and disease pests, evaluating outbreak conditions where the need arises, and summarizing and interpreting the accumulated data. In 1962, 601 reports were received: 451 for insects, 110 for disease, and 40 for animal pest damage. The Fish and Wildlife Service evaluates reports of animal damage.

Another major source of information is the Forest Disease Survey, a 10-year operation designed to appraise forest disease conditions on State, private and Federal forest lands in California. This survey, which is carried out by the Forest Service, employs randomly selected, temporary plots on which all trees are examined closely by skilled forest pathologists. Although complete results will not be available until about 1967, the survey has been planned so that preliminary summaries are possible. To date 554 plots supporting nearly 14,000 trees have been examined. For many diseases this body of information is now sufficiently great to reveal major trends. As additional data are added each year, these conclusions will be strengthened.

Survey information in 1962 was supplemented by numerous aerial examinations conducted by the California Division of Forestry, the National Park Service, the Forest Service, and several private companies.

HIGHLIGHTS OF FOREST PEST CONDITIONS IN 1962

Events of Statewide importance dominated the forest-pest situation in California during 1962.

The Mother Lode outbreak, an explosive bark-beetle infestation involving many ownerships in ten central and southern Sierra Nevada counties, continued to intensify and expanded into higher elevations and more valuable timber. Losses in 1962 are estimated to be in the neighborhood of one billion board feet. Salvage logging and direct-treatment control measures are being employed wherever possible, but to date these have been effective mainly in limiting the infestation locally.

The catastrophic Columbus Day storm of October 12 and 13, which swept the Pacific Coast, felled or damaged about 430 million board feet in Northern California, setting the stage for potential insect buildups in 1963 and 1964. By the end of the year good progress had been made in salvaging the affected timber.

Elsewhere in the State, insect activity followed familiar local patterns. Heavy losses due to western pine beetle attacks were sustained at several Southern California locations. Fir engravers continued to take a heavy toll in true fir stands from Modoc and Siskiyou Counties to San Bernardino County. Young-growth sugar and ponderosa pine stands near Miami Creek in Madera and Mariposa Counties again were heavily hit by mountain pine beetles; 53,000 trees were killed on about 11,000 acres in 1962. Ips bark beetles presented much less of a problem than formerly in the Mother Lode area. Flatheaded borer losses in Southern California were appreciably lower except at a few locations.

Forest disease conditions, which normally change little from year to year, remained about the same in 1962. Root disease received increased attention, and several new infection centers were reported. The Forest Disease Survey, now in its fifth year, is revealing a picture of widespread disease occurrence. The dwarfmistletoes of pines and true firs, cytospora canker of true fir, elytroderma needle cast of ponderosa and Jeffrey pine, and incense-cedar rust are emerging as some of the most prevalent forest diseases in the State. Drought and smog have been identified as the most likely causes of X-disease, a disorder of ponderosa pines at several locations in Southern California.

Several studies aimed at determining the extent of animal damage in specific problem areas were completed in 1962. The Animal Damage Survey, involving nearly 1,800 sample plots in the north coast region, and about 605 in the Sierra Nevada and Cascade Ranges was the most extensive of these. Other studies were concerned with porcupine damage. Forest animal pest conditions were generally unchanged in 1962.

COLUMBUS DAY BLOWDOWN

Winds of near-hurricane force blew down or damaged an estimated 430 million board feet of timber on four million acres of forest land in Northern California during the Columbus Day storm, October 12 and 13, 1962. The bulk of the concentrated destruction took place in a 50-mile-wide belt extending roughly northwest from Lake Almanor in Plumas County to Mount Shasta. Losses were also sustained in the north coast portion of the State where the blowdown took a more scattered pattern.

Although all forest types suffered, the true fir types and recently logged stands were hit the hardest, according to a cooperative aerial and ground survey made by State, Federal, and private foresters shortly after the storm. Damage was moderate to heavy on about 500,000 acres and scattered on an additional 3.5 million acres.

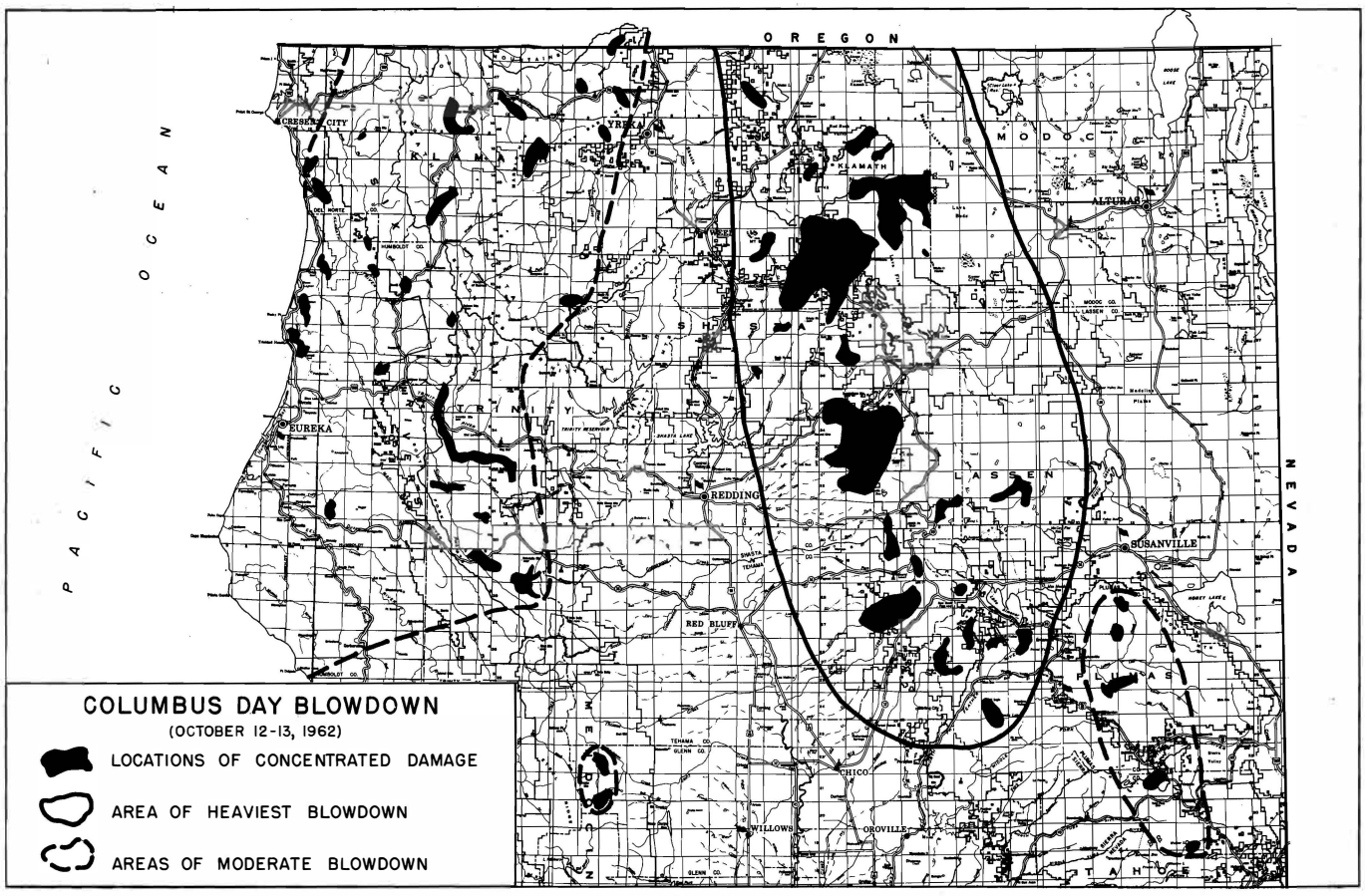
Past experience shows that extensive blowdown, particularly that involving ponderosa pine, sugar pine, and Douglas-fir, can set the stage for a buildup of bark beetles. Limited data on the true firs suggest that these species also represent a serious hazard. The following table summarizes forecasted insect activity for the near future.

ESTIMATED INSECT ACTIVITY DUE TO WINDTHROWN TIMBER

Tree Species	Insect Species	Hazard	Time of First Attack	Time of First Emergence of Insect From Blowdown Material
Ponderosa Pine	Western Pine Beetle	High	April 1963	June 1963
Sugar Pine	Mountain Pine Beetle	High	May 1963	September 1963
Douglas-Fir	Douglas-Fir Beetle	High	May 1963	June 1964
True Firs	Fir Engraver (Little Experience)	May be High	June 1963	June 1964
Lodgepole Pine	Mountain Pine Beetle	Very Low	June 1963	June 1964
Knobcone Pine	Five-Spined Ips	High	April 1963	June 1963
Incense-Cedar	No Experience			

The response of industry and of State and Federal forestry agencies was prompt and aggressive. Salvage operations were underway within a matter of days, and by the end of the year an appreciable amount of the down timber had been logged. Present plans call for completing the job on the concentrated blowdown by June 30, 1963. At its November meeting, the Council set up a local-action subcommittee to coordinate salvage activities, step-up insect detection, and to study the pest control implications of the disaster. The subcommittee met early in December to decide on a course of cooperative action to evaluate the situation and steps needed to minimize insect damage.

During the Columbus Day storm 430 million board feet were blown down in Northern California. Where the blowdown was concentrated and accessible, most of the merchantable logs are being salvaged. Unmerchantable material, and scattered inaccessible blowdown will provide a breeding ground from which insects can emerge in 1963 and 1964 to attack living trees.



MOUNTAIN PINE BEETLE, Dendroctonus monticolae. Losses in young-growth stands of sugar and ponderosa pine increased sharply in the Miami Creek, the Lewis Fork, and the Big Creek drainages, Mariposa and Madera Counties, where a partial survey of the 10,800-acre outbreak indicated that 1962 mortality averaged 7.1 trees per acre as compared with the 1961 loss of 1.5 trees per acre. Losses in 1962 are estimated to be 53,000 trees and 6 million board feet.

Sugar pine losses in old-growth stands increased at higher elevations from El Dorado County to Kern County, with the most severe outbreaks occuring near Dillion Canyon and Rogers Camp in Tulare County, and in the vicinity of Happy Gap, Fresno County.

The principal outbreaks in lodgepole pine continued to expand at Skunk Cabbage Creek and near Medicine Lake, Modoc County; and in the vicinity of Military Pass, Siskiyou County. Losses in young-growth ponderosa pine in the Joseph Creek and Mill Creek basin, Modoc County, remained at a high level. Thinning as a means of reducing losses was tested in the Joseph Creek area with promising results.

At Tuolumne Meadows, Yosemite National Park, lodgepole pines, weakened by needle miner defoliation, continue to succumb to light attacks.

Elsewhere in the State, mountain pine beetle activity was at a low level.

IPS, Ips, spp. Damage was much less prevalent than in 1961, particularly in the Mother Lode area and in Southern California.

FIR ENGRAVER, Scolytus ventralis. The Statewide epidemic in true fir continued unchecked with heaviest losses reported from Fort Bidwell, Modoc County; Roop Mountain, Lassen County; the Highway 50-Lake Tahoe area; Placer and El Dorado Counties; and Saw Pit Canyon, San Bernardino County. In the red fir stands near Dry Lake, Siskiyou County, the fir engraver has replaced the roundheaded fir borer as the major insect pest.

LODGEPOLE NEEDLE MINER, Evagora milleri. Stands of lodgepole pine in the Tuolumne Meadows outbreak, Yosemite National Park, showed a decided improvement in appearance after treatment with malathion in 1959 and 1961. Unsprayed portions of this outbreak remain heavily infested and additional control work is scheduled for 1963.

A small control project is planned for 1963 to suppress the Woods Creek outbreak in Kings Canyon National Park.

A closely related species continues to defoliate lodgepole pine stands near Sentinel Meadows, Mono County.

WESTERN PINE BEETLE, Dendroctonus brevicomis. The Mother Lode outbreak, a foothill and mid-elevation infestation that now extends from Placer County to Kern County, gave no sign of decline in 1962. A fall survey revealed that the outbreak has now expanded eastward into better ponderosa pine stands at higher elevations. It is estimated that 1 billion board feet of ponderosa pine was killed in 1962. Because the infestation is widespread and scattered, it is not feasible to attempt control in all areas. Control measures are being taken on Federal lands and by some timberland owners. These actions, the logging of infested trees and the chemical treatment

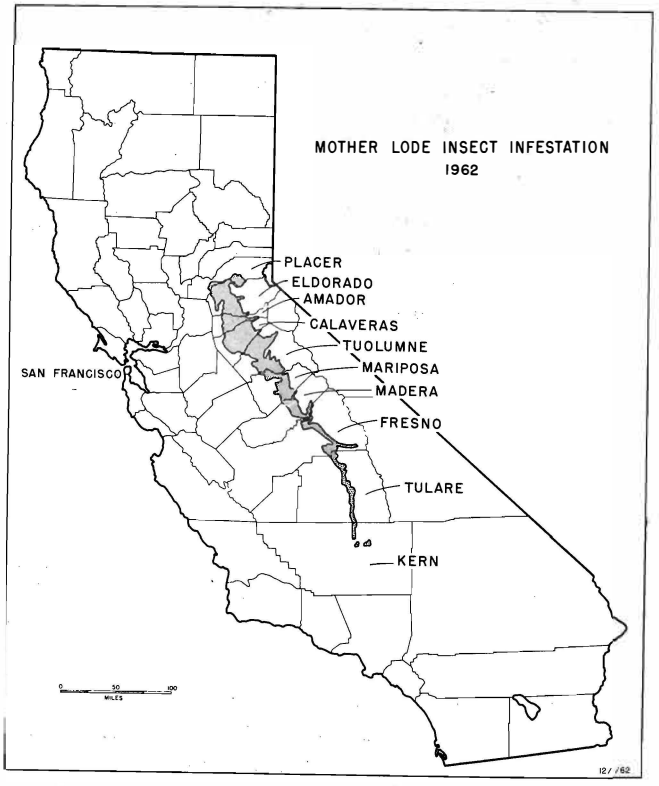
of unmerchantable material, while effective in limiting the infestation locally, have not yet been applied widely enough to check the outbreak. Much of the affected area is in small, privately owned holdings where a cooperative effort is necessary for effective control; so far little control work has been done on these lands.

In Southern California, high losses continue in the following areas: Julian and Lost Valley, San Diego County; Idyllwild-Lake Hemet, Riverside County; Lake Arrowhead and Barton Flats, San Bernardino County; Browns Flat, Los Angeles County; and, Figueroa Mountain, Santa Barbara County. An intense outbreak, requiring emergency control action, developed in ponderosa pine stands at Ranger Peak, Santa Barbara County.

In the northern part of the State, western pine beetle activity remained light; the principal infestations are at Blue Lake, Soup Creek, and Parker Creek, Modoc County; Round Mountain, Shasta County; Etsel Ridge, Mendocino County; and, Daggett Creek and Buckhorn Creek, Siskiyou County.

PINE REPRODUCTION WEEVIL, Cylindrocopturus eatoni. Plantations and natural reproduction throughout the low-elevation Sierra Nevada ponderosa pine type again sustained losses, particularly near Groveland, Tuolumne County.

CALIFORNIA FLATHEADED BORER, Melanophila californica. Although Jeffrey pine losses in Southern California are down appreciably from the 1957-1959 peak, outbreaks in the Laguna Mountains, San Diego County; near Garner Valley and Mountain Center, Riverside County; and at Mill Potrero, Kern County, presented serious problems in 1962. Throughout the Mother Lode outbreak, flatheads often were found to have teamed up



Old-growth ponderosa pines were killed by the western pine beetles at Skull Flat, Calaveras County. Tree Losses here exceeded 4,000 board feet per acre.

with western pine beetles in attacks on individual trees. Activity in ponderosa pine stands in Lassen and Modoc Counties was at a higher level than in 1961.

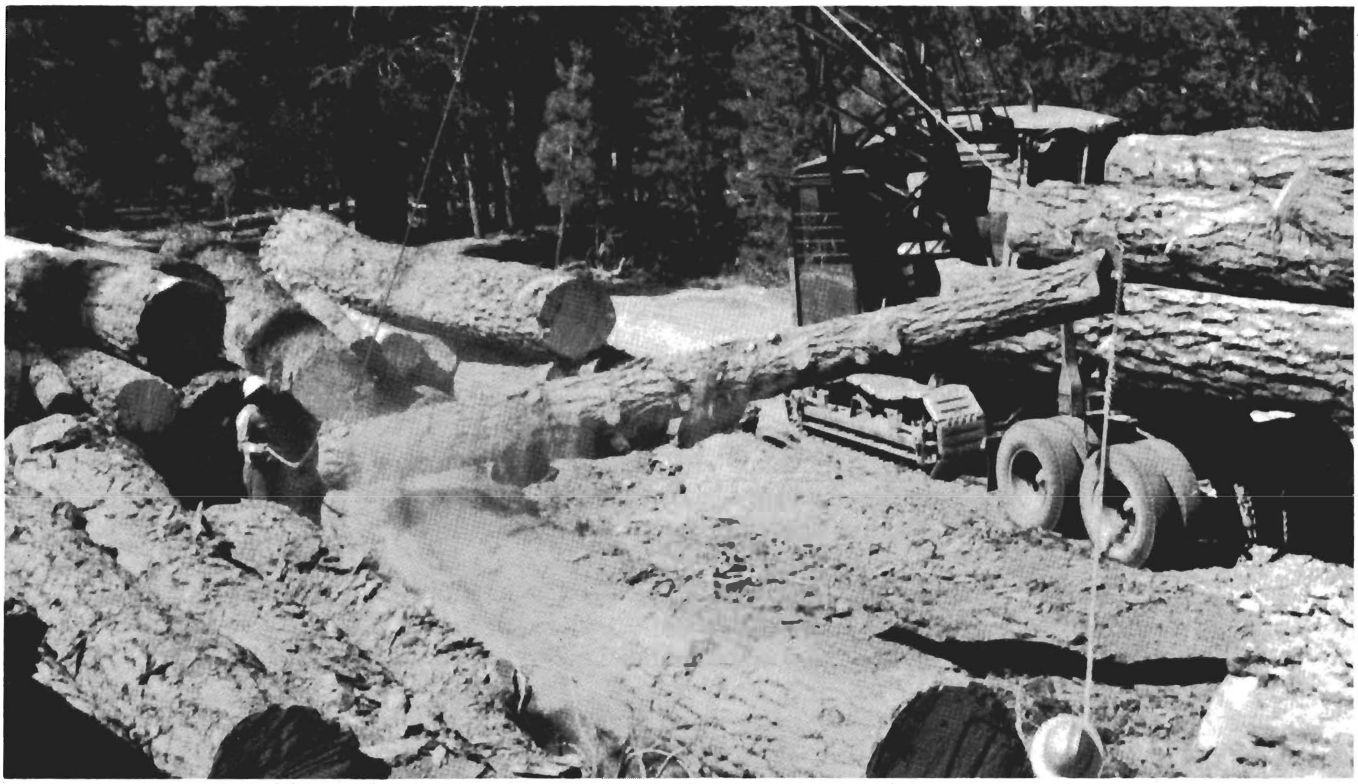
BLUE-SIDED TENT CATERPILLAR, Malacosoma constrictum. Oaks in the vicinity of Mt. Wilson and Red Box, Los Angeles County were badly defoliated by caterpillar attacks. Light defoliation was noted in Tulare and San Diego Counties.

LARGE ASPEN TORTRIX, Choristoneura conflictana. Infested aspen were discovered for the first time along Upper Bidwell Creek in Modoc County. In previously known infestations near Homestead Flat and Long Valley, Modoc and Lassen Counties, defoliation remained at a high level.

JEFFREY PINE BEETLE, Dendroctonus jeffreyi. Sanitation-salvage operations were applied to the Upper Deadman outbreak in Inyo County. In Northern California damage was negligible. Big Bear Valley, Snow Valley, Barton Flats, and Upper Santa Ana River in Southern California experienced damaging losses.

CEDAR BARK BEETLES, Phloeosinus spp. Persistent drought conditions throughout the lower mixed-conifer belt of the southern Sierra Nevada have resulted in a general buildup of bark beetles in incense-cedar.

WHITE FIR SAWFLIES, Neodiprion spp. Young stands of white firs being managed for Christmas tree production near Rush Creek, Modoc County, were attacked and damaged. Sawfly activity also was reported from Mineral, Tehama County.



Logging of insect-infested trees is the principal control method used to suppress bark beetle outbreak in the Mother Lode Infestation.

ROOT DISEASES. Unlike other forest pests, the diseases that attack the roots of trees are quite difficult to detect and often go unrecognized: severely infected trees frequently appear normal; visible fruiting bodies are seldom produced; and tissue culturing is often necessary to establish the cause of tree death. For these reasons, the survey and detection methods that are successful for other pests are much less effective for root diseases, and the status of these organisms in California is only partially known at present.

Root diseases have long been recognized as one of the most serious of pests confronting forest managers and have created major problems wherever intensive forest management has been practiced. In 1962, forest-disease survey, control, and research personnel gave increased attention to root diseases in native stands as well as in nurseries and plantations. The following conditions illustrate the impact of three root diseases.

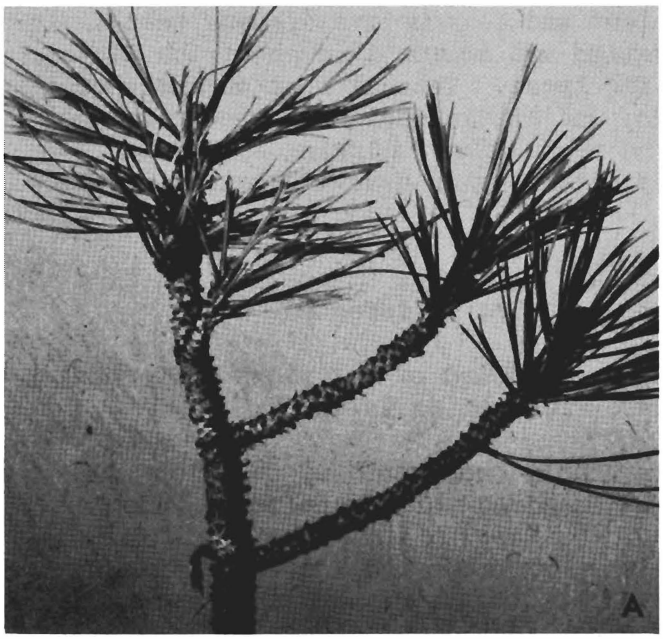
Fomes annosus: Small infection centers in which sugar pines and ponderosa pines of all ages are being killed were found scattered throughout four sections at Boggs Mountain State Forest, Lake County. Previously discovered infection centers near Blacks Mountain Experimental Forest and Hat Creek, Shasta and Lassen Counties, are still active.

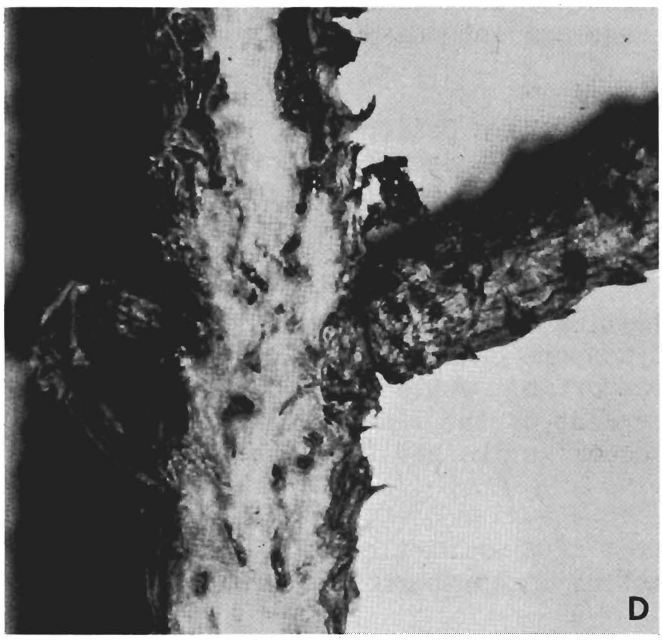
Several windthrown white firs near the Latour State Forest, Shasta County, were found to be infected. The disease had been active in these old-growth trees for many years, destroying the roots and predisposing them to windthrow. (These observations were made prior to the Columbus Day storm. It is expected that many of the windthrown trees in areas suffering scattered blowdown will be similarly infected; systematic examinations will be made in 1963.)

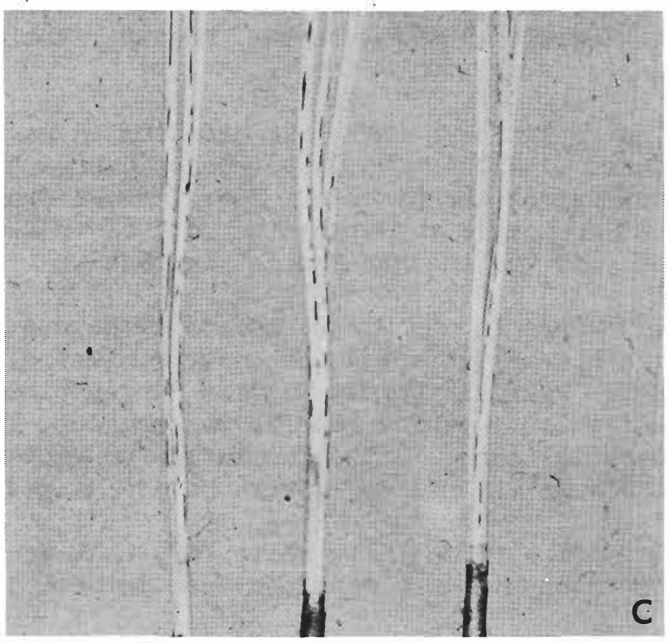
Fomes root disease killed a hybrid pine seedling in a plantation near Yreka, Siskiyou County. It was found on Jeffrey pine on the eastside of Mount Shasta, and continues to threaten the pine arboretum of the Institute of Forest Genetics at Placerville.

Armillaria mellea: Several Jeffrey pines have been killed in the Manzanita Chute plantation near Viola, Shasta County. Over a period of years, 40 ponderosa pines have been killed in an infection center at Boggs Mountain State Forest that measures 100 yards in diameter. Infection was found at several locations in eastern Lassen County and at Mount Tamalpais State Park, Marin County, where the disease is causing damage in stands of oak trees. Many of the roots of a windthrown red fir near Tahoe City, Placer County, were found to be dead or dying from this disease; the tree was a casualty of the Columbus Day storm. One rust-resistant sugar pine tree at the Badger Hill Seed Orchard, near Camino, Eldorado County, was killed by this disease.

Verticicladiella wagenerii: Scattered groups of ponderosa and Jeffrey pines near Blacks Mountain, Lassen County, are infected. An infection center in a pinyon pine stand near Lake Baldwin, San Bernardino County, continues to increase in size. Numerous pinyon pines growing along Highway 395 south of Topaz Lake, Mono County, are dying of this root disease.







Elytroderma needle blight is wind-borne fungus disease that commonly becomes perennial in the twigs of ponderosa and Jeffrey pines, forming, at times, massive brooms that superficially resemble dwarfmistletoe brooms. It is found occasionally on lodgepole and knobcone pine. Under most forest conditions it is not a serious pest, but in some situations it can be a severely-damaging parasite. Short needles and thin foliage that consists mainly of the last two-years' growth are identification characteristics (A). Some severely infected trees do not produce pronounced brooms (B). The long, narrow fruiting bodies that appear on two-year-old needles are positive identification (C). When infected twigs are sliced, the brownish flecks and spots typical of the disease are readily discernible (D). Note: Twig in photograph D is the same as in photograph A.

DWARFMISTLETOE, Arceuthobium spp. The dwarfmistletoe of pines, true firs, and Douglas-fir is one of California's most prevalent and destructive disease pests. Infections of major importance to timber production are common throughout the State, particularly in the ponderosa pine and true fir types. Intensification and spread of dwarfmistletoe takes place slowly, however, and little change in the prevalence of this pest can be noted from one year to the next. The following statistics taken from Table 4, illustrate the extent and intensity of dwarfmistletoe in California.

Red Fir: Infected trees were found on nearly half the plots supporting red fir; more than one-third of the trees examined were found to be infected.

White Fir: Infected trees were found on nearly one-third of the plots supporting white fir; one-sixth of the trees examined were found to be infected.

Ponderosa Pine: Infected trees were found on nearly one-fourth of the plots supporting ponderosa pine; one-tenth of the trees examined were found to be infected.

CYTOSPORA CANKER, Cytospora abietis. In healthy, vigorous red and white firs, cytospora canker is usually a minor parasite that attacks only branches and twigs already weakened by shading or other causes; under such circumstances it causes little damage. During periods of moisture stress or when branches are heavily infected with dwarfmistletoe, however, the disease can intensify rapidly, causing major damage to the host.

The recent subnormal precipitation in parts of Northern California, particularly in parts of Siskiyou County, weakened host trees at some locations allowing a major buildup of the disease. Heavy damage from this flare-up continues to take place, but the ample precipitation in 1962 increased tree vigor, and the outbreak may subside if the weather remains favorable.

Elsewhere in the State, severe cytospora infection is common in true fir stands that are heavily infected with dwarfmistletoe. Cytospora canker infection was found on about half the Forest Disease Survey plots supporting white fir and on virtually all those on which red fir was present; 16 percent of the trees were infected in each instance. Extensive infection centers occur in the red fir type throughout the southern Cascade and Sierra Nevada Ranges.

True firs, especially white fir, that were free of dwarfmistletoe but badly damaged by cytospora were reported from several locations in Northern California.

NEEDLE DISEASES. Forest Disease Survey records now show that elytroderma needle blight, Elytroderma deformans, occurs commonly throughout the ponderosa and Jeffrey pine forests of the State; the disease was found on more than one-fourth of the plots bearing these species and on about 10 percent of the trees examined. It was encountered much more frequently than in recent years indicating good spread conditions in the spring and summer of 1961.

Other needle blights, needle casts and molds, while somewhat more prevalent than in 1961, appeared to be causing little harm.

RUST ON CONIFERS. The status of white pine blister rust remained unchanged except for local spread and intensification on sugar pine in the northern part of the State. Little pine-to-ribes spread took place in the spring of 1962 for either white pine blister rust or the native pinyon rust.

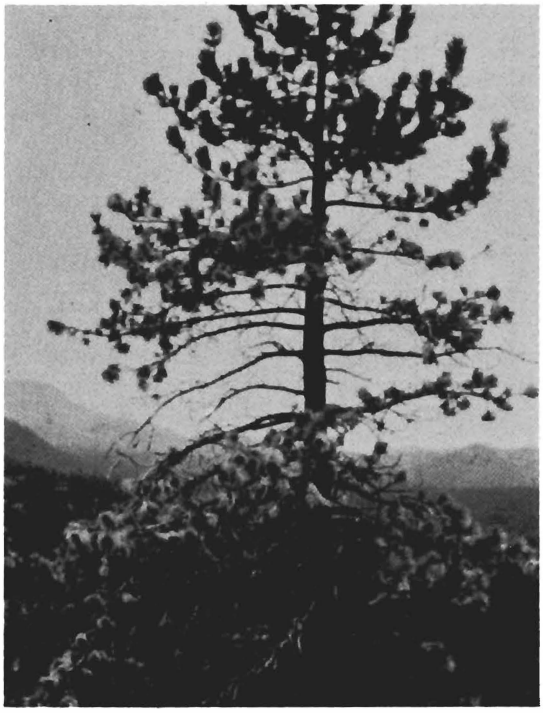
The known range of yellow witches' broom, Melampsorella caryophyllacearum, a rust infecting red and white fir, was extended southward in both the Sierra Nevada and Coast Ranges by collections made at Corral Bottom, Trinity County, and at Thomas A. Edison Reservoir, Fresno County.

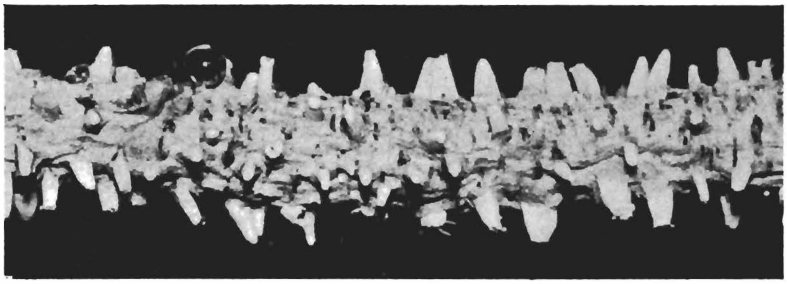
Incense-cedar rust, Gymnosporangium libocedri, was shown by the Forest Disease Survey to be one of the most commonly encountered forest tree diseases in California. It has been found on practically all of the plots on which incense-cedar occurred and on three-quarters of the host trees examined. The brooms formed by this disease are frequently mistaken for dwarfmistletoe, which does not occur on incense-cedar or for true mistletoe, Phorandendron juniperinum var. libocedri, which is common, but much less abundant.

CHLOROTIC DECLINE OF PONDEROSA PINE. Drought or smog or a combination of the two are now believed to be the cause of the disorder known as X-disease. This disorder, which afflicts ponderosa pine on several thousand acres in Southern California, was as aggressive as ever in 1962 after a period of lessened activity in 1961.

DISEASES OF UNDETERMINED CAUSE. Numerous white firs, six to eight inches in diameter, have died in the vicinity of North Peak, San Diego County, as a result of subnormal precipitation and a bacterial infection introduced by insect attack.

RESULTS OF FOREST DISEASE SURVEY. The Forest Disease Survey has now been under way for five years; 554 plots have been taken and 13,950 trees have been examined. Results to date are given in Table 4.



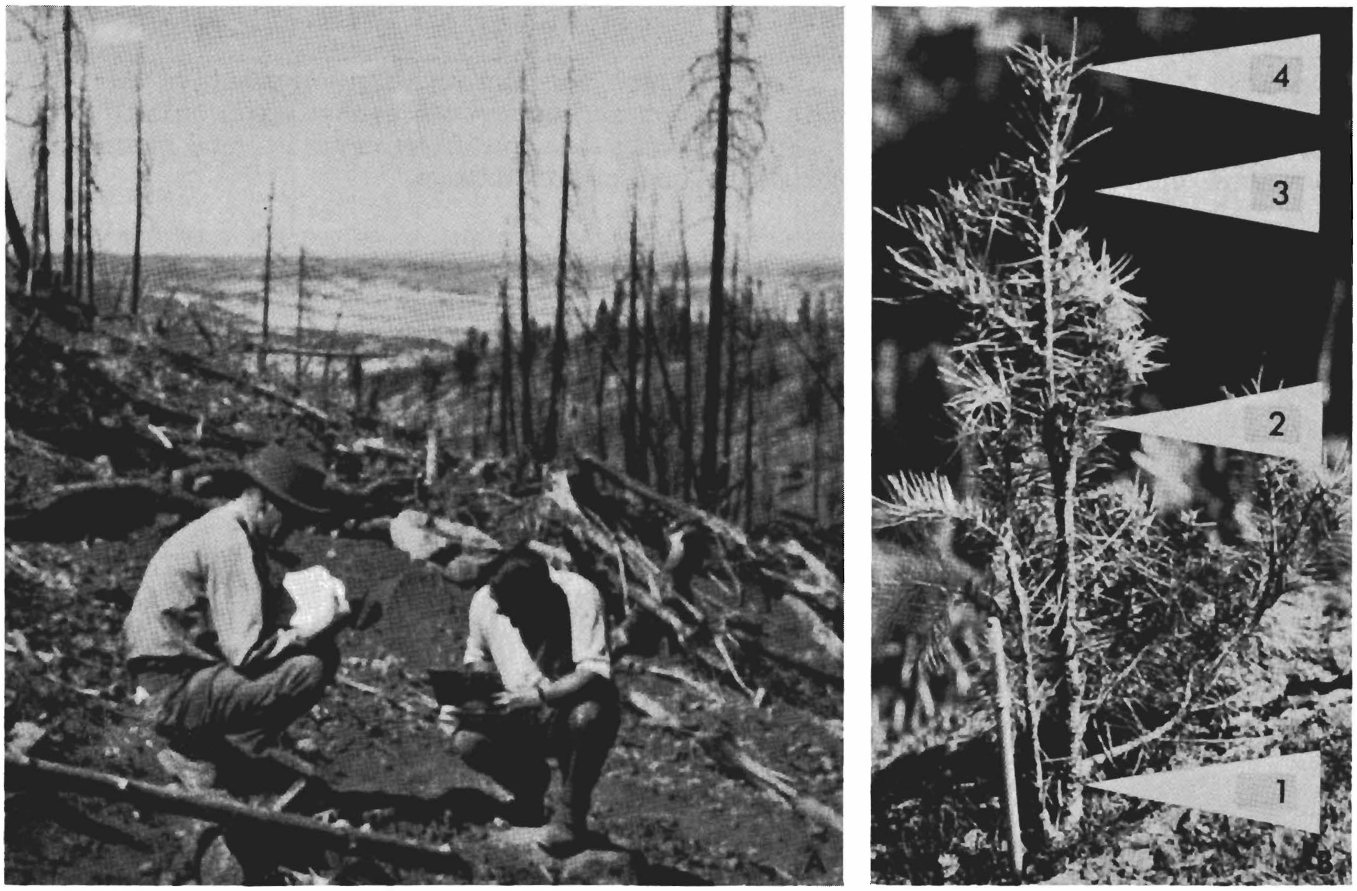


Initial attacks of limb rust frequently take place in the central crown of pole-sized and mature Jeffrey pines. The disease then spreads by mycelial growth to adjacent limbs, killing them and gradually creating a characteristic opening in the crown of the tree (A). Aeciospores are produced in tongue-shaped peridia that frequently persist into the second year (B). Spore production is confined to limbs and twigs under one inch in diameter; infected branches are never swollen. No alternate host is known for this rust.

PORCUPINES. Although porcupine damage appears to have declined some, these rodents remain a serious threat, especially to young pine plantations where losses as high as 20 percent can take place in a single season. The Weyerhaeuser bait box, a primary control tool, is now widely used in young plantations.

RABBITS. Rabbit damage is not extensive, but continues to be of importance locally. Reports of damage were received, from the northwestern counties of the State, and one report, attributing damage to snowshoe hares, was received from the Lassen National Forest where an estimated 1,000 trees were damaged.

DEER AND CATTLE. Demonstration plots were established by several companies and by State and National Forests to show the effect of deer and cattle browse on young conifers. The repellent Arason 42-S was used by some forest managers to give initial protection from browse damage.



Animal damage in plantations and natural regeneration was recorded as a part of the Animal Damage Survey. The plantation shown in (A) is at the site of the 1960 Adin Pass Fire on the Modoc National Forest. The Douglas-fir seedling from Humboldt County shown in (B) was browsed four times by deer. It is 10 years old and should be 12 feet tall. Its present height is 20 inches.

Every tree on one large plantation on the Klamath National Forest was reported to have been browsed or otherwise damaged by cattle.

BEAR. Damage by bears continues to be a problem in the north-coast counties. A report from Humboldt County attributed damage on an estimated 12,000 acres to a combination of rabbits, deer, and bear.

BIRDS. A single report involving foliage clipping by grouse was received. More important than foliage clipping, however, is the loss of seed resulting from the seed-eating birds. State and Forest Service nurseries are now treating seeds with Endrin and Arasan 75, both of which afford good protection.

SQUIRRELS. The abundant debarking by squirrels that was experienced in 1961 was not reported in 1962. However, considerable loss of seed from cone-cutting activity was observed. Seed production areas totalling 100 acres on the Modoc, Lassen, and Stanislaus National Forests received effective protection by the use of 18-inch aluminum bands placed at eye height on each tree.

GOPHERS. Although only one report of gopher damage was received, these animals usually injure only the roots of trees, and their damage often goes unnoticed unless the tree dies.

WOODRATS. Woodrat damage was reported from two locations. Such damage is not extensive, but can be of importance locally. Debarking by woodrats superficially resembles porcupine girdling on young trees.

MICE. Mice continue to be a problem in direct seeding operations, but equally important is their depredation of natural seedfall. Rodent control measures taken prior to natural seedfall, and the treatment of artificially planted seeds with Endrin and Arasan 75 repellent are being employed successfully to increase survival after germination.

FOREST PEST CONTROL ACTION COUNCIL ENDORSEMENTS - 1962

At its annual meeting in November, the Council took the following actions:

1. Reviewed a report on pest research needs prepared by a special committee. The report which was referred to and subsequently approved by the executive committee recommends increased effort on pest surveys and detection, and increased research on animal, insect, and disease pests; it was forwarded to all Federal, State, and educational agencies concerned. Expansion of research on animals in the West and the establishment of an animal research center in California by the Fish and Wildlife Service was also proposed.

2. Endorsed the insect control projects listed in Table 3.

3. Instructed the Council chairman to appoint a local subcommittee to initiate united action from all agencies concerned with the Columbus Day blowdown problem.

4. Recommended that a formal report of the blowdown situation be presented to the State Board of Forestry.

5. Recommended that the National Park Service film, "Ghosts of Tioga," be shown to the State Board of Forestry.

6. Recommended that "Ghosts of Tioga" and "Development of Lindane for the Control of Bark Beetles," films prepared by the National Park Service and the Pacific Southwest Forest and Range Experiment Station, respectively be made available by those agencies for public showing.

7. Recommended that the Mother Lode subcommittee be continued, and that its zone of activity be extended northward.

8. Recommended that the publicity campaign for the blowdown situation and the Mother Lode outbreak be continued.

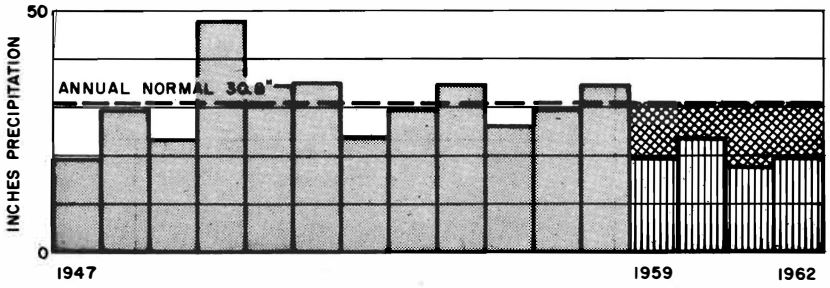
9. Urged that scientists reporting results of animal-damage studies publish their findings in widely-read periodicals such as the Journal of Forestry.

10. Recommended approval of amendments to certain zones of infestation in Southern California to include important fringe areas.

11. Encouraged research on forest management keyed to drought survival.

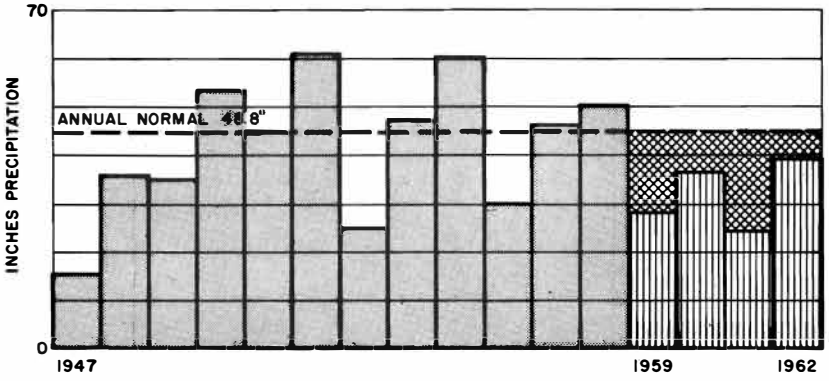
HEALTHY TREES NEED NORMAL RAINFALL

1959-1962 PRECIPITATION AT SOME LOCATIONS WAS SUBNORMAL



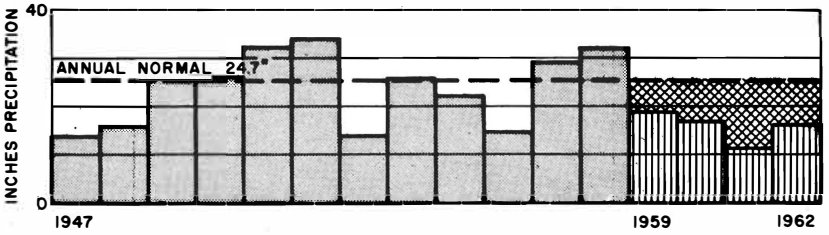
MOTHER LODE AREA
(WEST POINT, CALAVERAS CO.)
TOTAL 4-YEAR PRECIPITATION 1959-1962

NORMAL	123 In.
RECEIVED	79 In.
DEFICIT	44 In.



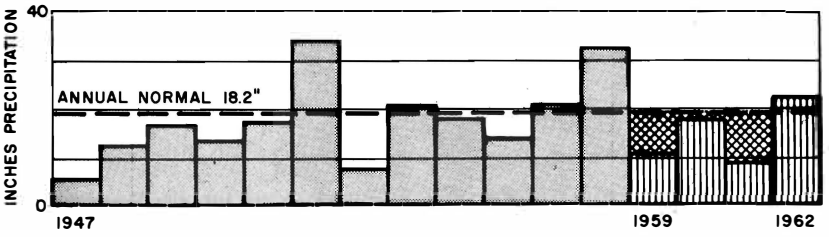
SOUTHERN SIERRA
(GRANT GROVE, SEQUOIA N. P.)
TOTAL 4-YEAR PRECIPITATION 1959-1962

NORMAL	179 In.
RECEIVED	126 In.
DEFICIT	53 In.



SAN BERNARDINO NATIONAL FOREST
(IDYLLWILD - SAN JACINTO R. S.)
TOTAL 4-YEAR PRECIPITATION 1959-1962

NORMAL	99 In.
RECEIVED	63 In.
DEFICIT	36 In.



LOS PADRES NATIONAL FOREST
(FIGUEROA MTN.)
TOTAL 4-YEAR PRECIPITATION 1959-1962

NORMAL	73 In.
RECEIVED	57 In.
DEFICIT	16 In.

During drought periods many small feeding roots on forest trees are killed and the amount of foliage is reduced accordingly. This retards tree growth and vigor and lowers the tree's resistance to insect and disease attack. From 1959 to 1962, the forest areas illustrated here suffered precipitation deficits of one-fourth to one-third of total normal precipitation for the period. Without a return to normal soil-moisture conditions--which may require more than a single season's rainfall--some pest control actions will be only partially successful.